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Kinetic Energy Recovery System (KERS) for Conveyor belt

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Abstract : *In today's scenario conveyor belt plays a vital role in transferring goods and commodities from one place to another using conventional energy sources, their main purpose is to transfer the goods with less consumption of power thereby acquiring the efficient management of the power. The conservation of energy is also seen with other factors that influence over the transfer of materials. By using energy storing devices the process can be done in more modest and in an effective way. Flywheel is the plate which is used to store the energy from the transmitted power, it is made up of cast iron with specific geometric dimensions and that holds up the power through kinetic energy reserve within the body and hence then delivers when the machine gets idolized and the power stored is transferred to the unit which needs. In automobile industry and applications, flywheel is the most crucial element which boosts up the constant power supply and that governs for the solution for the eclectic distribution of power and performance of the engines. The flywheel stores energy & helps to smooth out the operation of the engine. It will enable smoother starts from rest & helps to reduce the work the engine has to do in all parts of its operating range. It also tends to dampen vibration particularly in four cylinder engines. A belt is a loop of flexible material used to link two or more rotating shafts mechanically. As a source of motion, a conveyor belt is one application where the belt is conjoint with purpose of flywheel; the drive belt is used to transfer power from the engine's flywheel.*

Keywords: *KERS, Flywheel powered conveyor belt, Kinetic Energy recovery system for conveyor belt*

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I. INTRODUCTION

Conveyor belt which runs through pulley mechanism, generally powered by electric motor. In case of emergency, like power shut down. There is a need to drive the belt accordingly in order to distribute the components. If the belt is driven manually then the work done by the worker would be high and would get exhausted so to reduce the strain and thereby drive the belt simultaneously, we need an additional component which is flywheel. By using the above components and suitable mechanism which involves usage of flywheel that stores excess energy and releases out whenever there is a need for it , we would be able to drive a conveyor belt manually and thereby with less work concentration involved in it. Also the belt could be stopped for multiple stations.

Fig.1 Conveyor belt

II. CONSTRUCTION

The assembly consist of frame which is welded with edge to edge using arc welding and bearings are welded wherever the shaft is to be rotated and with the support of bearings which are roller bearings of 52100 chrome steel material, the shafts which are made of mild steel are attached and then sprocket chain is done at the base with altered correction in the frame to provide ergonomic fit and the free wheel of that set up is directed to shaft of other end and that shaft consist of a pulley that is hence then connected to flywheel at the upper portion of the frame via belt of rubber composite and the flywheel is in turn connected with the pulley at type through conveyor belt which is of EVA (Ethylene Vinyl Acetate) material that is to be driven.

III. COMPONENTS USED

Components used for raising the construction are

i Chain Ring
ii Chain
iii Free Wheel
iv Pulley
v Belt
vi Ball Bearing
vii Mild steel Shaft
viii Flywheel
ix Conveyor Belt
x Mild steel bar for Frame

IV. MECHANISM AND POWER FLOW

Conveyor Belt supported by flywheel uses the combined mechanism of pulley and flywheel. The belt is driven by two pulleys which is hand driven or motorized accordingly. Power is transmitted to flywheel through chain that is in turn connected to a supportive pulley, after gaining the required momentum the flywheel stores the energy from the pulley at particular speed of the driven crank and when there is requirement of power hence then it releases the energy to the conveyor belt which can be further controlled using clutch drive system. This enhances the user experience which lowers the burden and can be improvised by assigning stations accordingly the crank can be controlled by the user.

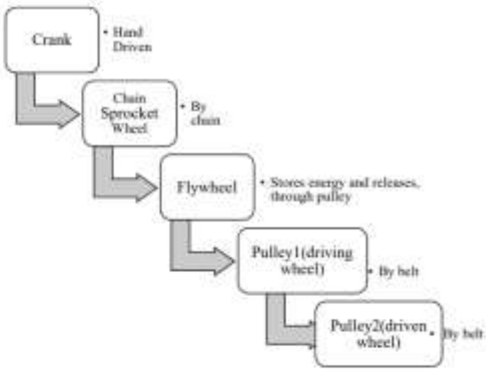

Fig.2 Power flow

The kinetic energy is being regenerated with the help of flywheel connected to the driven shaft of the assembly provides extra boost of power and would last the rotation of the driven member (here the conveyor belt) for 30 to 40% of extra time to rest. Thus saves power and effort for the labor which is suitable to get operated when there is loss of power in the industrial plant.

V. Computer Aided Design of Conveyor belt supported by flywheel

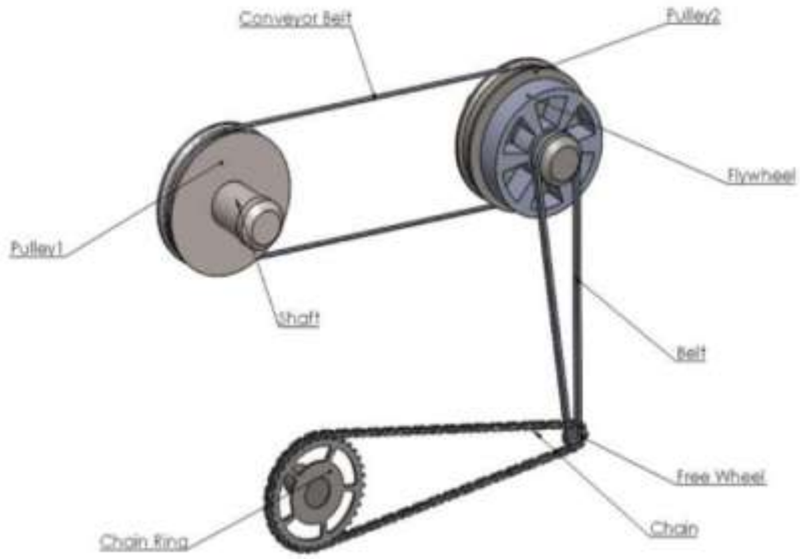

Fig.3 CAD of conveyor belt supported by flywheel

VI. Analysis of Flywheel

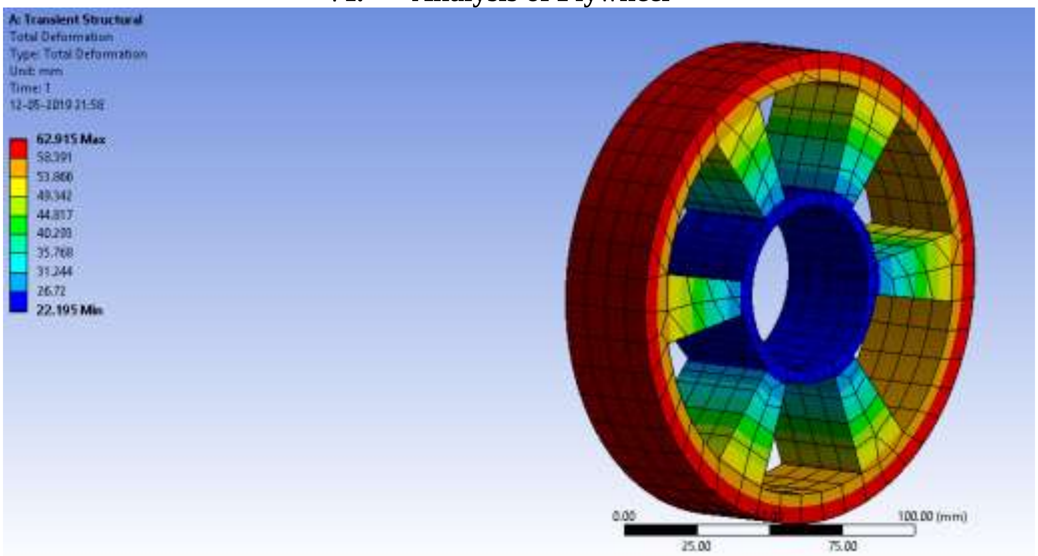

Fig.4 Transitional Analysis of Flywheel: Total Deformation

From fig.4 it can be inferred that the flywheel is transitionally analyzed by applying moment on the outer surface (rim) as well as the inner hole which is connected to the driven shaft of the assembly, it is set to obtain the solution for total deformation which yields maximum deformation of 62.15mm on the outer rim and minimum of 22.195mm around the hole which is cycled for 20 turns respectively.

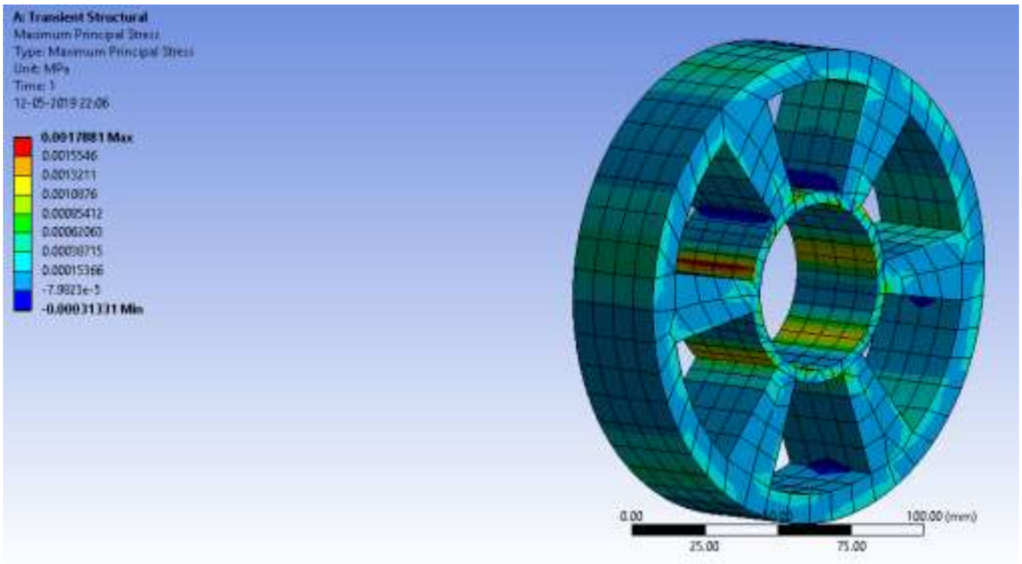

Fig.5 Transitional Analysis of Flywheel: Maximum Principal Stress

Flywheel used is also transitionally analyzed on to get solution for maximum principal stress of 0.0017881MPa over the fillets of spokes of the flywheel which is a tensile stress and has compressive stress of 0.00031331 Mpa over the outer surface of the flywheel due to the tension caused by the belt-pulley arrangement. It is also confined for 20 turns respectively

The above simulations are done with the moment as the primary parameter of 12 to 19 Nmm.

VII. Calculation Of Flywheel's Output

7.1 Nomenclature

a) v = Final velocity of freewheel at the end of discharging cycle (m/s)
b) u = Initial velocity of freewheel at the starting of discharging (m/s)
c) a = Acceleration of freewheel (m/s^2)
d) E = Total energy of system (Joules)
e) D_f = Diameter of flywheel (mm)
f) R_f = Radius of flywheel (mm)
g) F_a = Inertial Force (N) at 'a' m/s^2
h) F_r = Rolling Resistance (N)
i) ρ = Density (kg/m^3)
j) F_f = Frictional Resistance (N)
k) F = Total force (N)
l) T = Torque (Nmm)
m) E_{fl} = Output energy of flywheel (Joules)

7.2 Design Of Flywheel

Material used is Cast Iron.
Calculation for the energy stored in the flywheel:
Load added = 5kg
Other payloads = 1kg
Allowance for flywheel weight = 1kg
Total weight =7 kg
Let us assume that the flywheel stores enough energy to take the whole system from rest to 10 km/hr.
v = 10km/hr = 50/18 = 2.78m/sec
u = 0km/hr = 0m/sec
Time = 5sec
$a = (v^2 – u^2)/2s$
$a = 0.556\ m/s^2$
Energy of the system when it reaches 10km/hr
$KE = ½mv^2 = 35$ joules
So let us calculate the rpm or speed of the flywheel

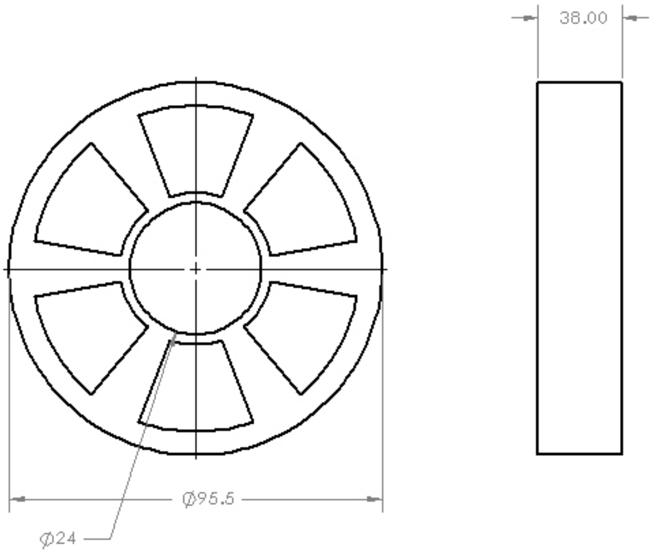

Fig.6(a) Front View of Flywheel **Fig.6(b) Side View of Flywheel**

D_f = Outer Diameter of the flywheel = 95.5 mm
Number of revolution made by the flywheel at 10kmph
$v/2\pi R_f$ = 9.27 rpm
Force required to take the pulley from rest to 10kmph in 5 sec

$F_a = ma = 3.892$ N
Now considering the rolling resistance of the flywheel
F_r = 10 watt at 10kmph = 0.36N
$F = F_a + F_r + F_f$
$F = 3.892 + 0.36 + 10 = 14.252$ N

Energy released by flywheel
$E_{fl} = F \times \text{displacement} = F \times (v^2 - u^2)/2a$
$E_{fl} = 14.252 \times 2.782 / (2 \times 0.556)$
$E_{fl} = 99.05$ J
[Note: We are using a circular disk flywheel; Max dia. = 95 mm, Max thickness = 20 mm]

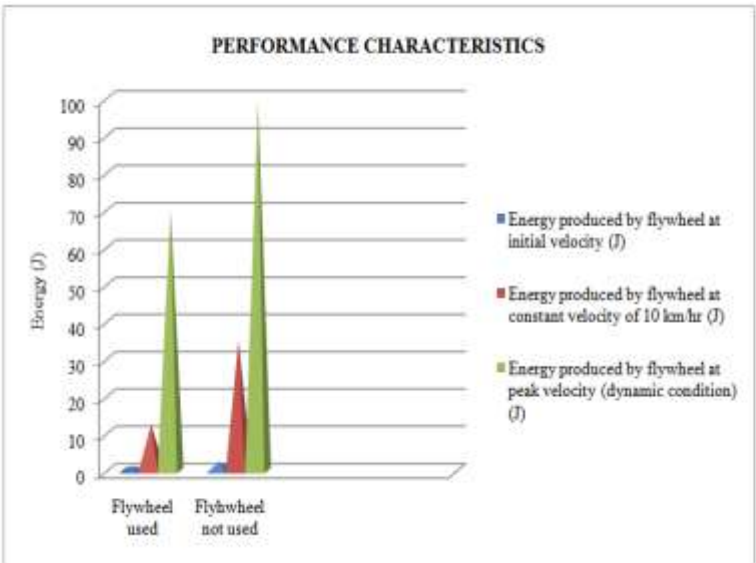

Fig.7 Performance characteristics graph

VIII. Conclusion

In this assembly we use the power from the crank and the flywheel is used to save excess power flow from the feed and would liberate it to the driven member which is the conveyor belt in this case and would help in transmitting the power seamlessly. The article can further enhanced when there exist multiple stations in an industry when this arrangement is fixed as a driving member in the primary station then the primary user can control the motion for the next two or more stations which is based on the requirement.

And hence this help to avoid printed electronic boards usage that may become unstable if there exists any power cut or short circuited scenario, by using this project's ideology the work load can be reduced for the user as well as the energy consumption can be brought down.

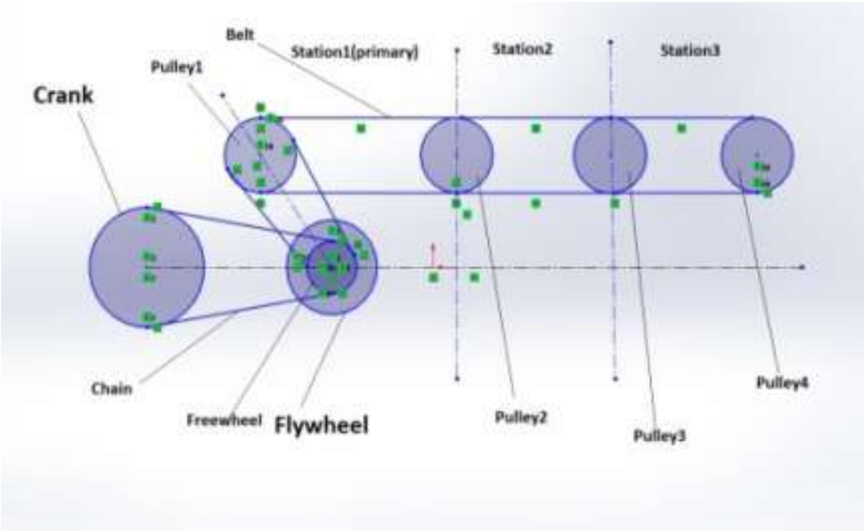

Fig.7 Application via stations

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